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DYE 2 POSITION AND TOPOGRAPHY 1986(U) COPENHAGEN UNIV
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| 19. ABSTRACT (Continue on reverse if necessary and identify by block number) The main objective was to obtain a precise "fix", i.e., latitude, longitude and elevation at station Dye-2 on the Greenland ice cap. The site expedition established a benchmark 100 meters from Dye-2 and set up a Geociever with theodolite transportation to the site. Topographical data for the Geociever site is provided in this report. | | | | | |
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DYE 2 POSITION AND TOPOGRAPHY 1986

Report on a joint program between

U. S. Army CRREL

and

Geophysical Institute, University of Copenhagen

under contract DAJA45-86-M-0490

by

N. S. Gundestrup



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Dye 2 position and topography 1986.

Purpose :

- (1) To provide a satellite based fixed point close to Dye 2 for position and elevation reference. By remeasurement of this point, the surface velocity can be calculated;
- (2) To measure the surface topography within 3 km from the station. Irregular ice flow should be accompanied by changes in surface slope, thus the surface topography can be used as an indicator for variations in surface strain.

Equipment

The satellite receiver used is constructed by University of Copenhagen (UCPH). This receiver has demonstrated an accuracy of better than 1 meter in the horizontal plane, and better than 1.5 meter in elevation. The topography is performed with a Wild T16 theodolite equipped with a Wild DI200 distance meter. The theodolite has automatic vertical zero.

Data processing

Satellite fix.

The satellite information is stored on tape in the field. In the lab., the information is transferred to the Sperry 1192 mainframe at the University Computing Center. Abnormal satellite passes are removed by a preprocessor, and the result checked manually. The data are then mixed with the precise satellite ephemeris (provided by DMATHC) and the position calculated by the DMATHC developed DOPPLR program. Thus, the position is compatible with any position calculated by DMATHC using the precise ephemeris. The estimated error is less than 1 meter in the horizontal plane, and less than 1.5 meter in elevation.

In order to reference the elevation to mean sea level in stead of the WGS72 ellipsoid, the estimated geoidheight is calculated from geoid data provided by Rapp, Ohio University. The estimated geoid height is 40 meter. As the measured antenna height above the ellipsoid is 2152.52 m, and the antenna was 1.05 m above the snow, the snow surface at the geociever site is 2111.5 meter above sea level.

Surface topography

The main elevation reference is the snow surface at the satellite fix. In order to provide this reference, an optical marker (prism) was mounted 0.5

meter from the satellite antenna. The terrain close to the station is very irregular due the snow removal operations, thus two observation posts had to be used, both west of the Dye station and close to the garage. The position of these points relative to the satellite site was calculated from the distance and azimuth to the marker prism at the satellite site. The true azimuth was calculated from sun shots. The position of the Dye station was determined from prisms at the corner legs. The main reference is the south side of the southwestern leg - that close to the entrance latter. The distance data from the DI2000 is corrected for barometric pressure, temperature and humidity in the distance meter itself. The elevation reading and the distance then give the elevation changes, corrected for refraction and earth curvature. This calculation was done at the lab using a Lotus 123 program (se enclosure 4).

The corrected elevation measurements were used as input to the "UNIRAS" program. Using the "Geopak" routines, and some degree of smoothing, the topography shown as enclosure 3 is obtained. All observed points are marked with a small dot. Due to the low data density in some areas, the topography have some anomalies. This is an artifact from the data processing.

Compared with the topography around Dye 3, the topography is relative regular. The surface undulations are not very strong. The ice flow is in direction 285 degree true.

Schedule

The team, consisting of N. Gundestrup and L. Riishøjgård arrived Dye 2 with 109'th TAG May 22. The same day, the satellite receiver was set up. Passes from May 23 to May 28 were used for the calculations. The measurements of the surface topography took place in the days May 24 to May 26. The main problems were obstacles due to snow drifts and periodic low visibility. May 26, the measurements had to stop because excessive snow drifts made measurements impossible. The team left Dye 2 for Sondre Stromfjord May 28 by 109'th TAG.

Enclosures:

1. Photo of reference at Dye 2 station
2. DMA sheet with satellite fix data.
3. Surface topography
4. Lotus sheet of elevation measurements



Enclosure 1, photo of reference at Dye 2.

The main reference at the Dye station is the column close to the entrance latter. On the photo, the prism, and the yellow target just below the prism is visible. The reference is 44 cm above the horizontal beam.

SUMMARY OF SATELLITE-OBSERVED STATION

| | | |
|---|---|---|
| STATION NAME/LOCAL NUMBER Dye 2 1986 | LOCATION Pole 600 m south of station | DOPPLER NO. |
| STAMPING ON MARK | | |
| AGENCY (CAST IN MARK) | | TYPE OF STATION MARK 6 m glassfiber pole |

DOPPLER OBSERVATIONS

| | | |
|------------------------------------|--|--|
| EQUIPMENT/SERIAL NO. GIL, no. 2 | HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK: 1.05 m above snow | TRACKING EQUIPMENT REFERENCE POINT |
| OBSERVED BY (AGENCY) GIL | SATELLITE(S) OBSERVED 20,50 | PERIOD OF OCCUPATION 860523-860528, day 143 |

SATELLITE-DERIVED COORDINATES

| | | | | | | |
|--|---------------------------------------|----------------------|---|-----------------------------|---------------------|-------------------------|
| PASSES ACCEPTED 40 | DEGREES OF FREEDOM: 742 | RESIDUAL RMS 0.25 | STATION SET NSWC 9Z-2 | GRAVITY MODEL NSWC 10E-1 | ELLIPSOID WGS-72 | MINIMUM ELEV. ANGLE: 10 |
| (Satellite-derived coordinates referred to station mark) antenna | | | | | | |
| ϕ 66.485162 66 29 06.584 | λ 313.701451 313 42 05.222 | h 2152.52 | ACCURACY (local) 0.229 0.217 0.157 | | | |
| x 1,763,759.74 | y -1,845,575.59 | z 5,827,715.02 | | | | |
| (Satellite-derived coordinates of station mark transformed to local datum) | | | | | | |
| ϕ | λ | h | DATUM | | | |
| x | y | z | ELLIPSOID | | | |
| Δx | Δy | Δz | DATE OF TRANSFORMATION | | | |

GROUND SURVEY COORDINATES OF STATION MARK

| | | | |
|-------------------------|-------------------------|--------------------------|----------------------|
| ϕ | λ | DATUM (HORIZONTAL) | ELLIPSOID |
| DATE OF ADJUSTMENT | ORDER | SURVEY BY (AGENCY) | DATE |
| LOCATION OF SURVEY DATA | | | |
| ELEVATION (M) | DATUM (VERTICAL) | GEOID HEIGHT (M) 40 m | ELLIPSOID HEIGHT (M) |
| ORDER (ELEV.) | ESTABLISHED BY (AGENCY) | DATE | SOURCE OF (M) |

CONNECTION TO LOCAL CONTROL

| FROM | TO | () AZ FROM NORTH | DISTANCE |
|------|----|-------------------|----------|
| | | | |
| | | | |
| | | | |
| | | | |
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| | | | |
| | | | |

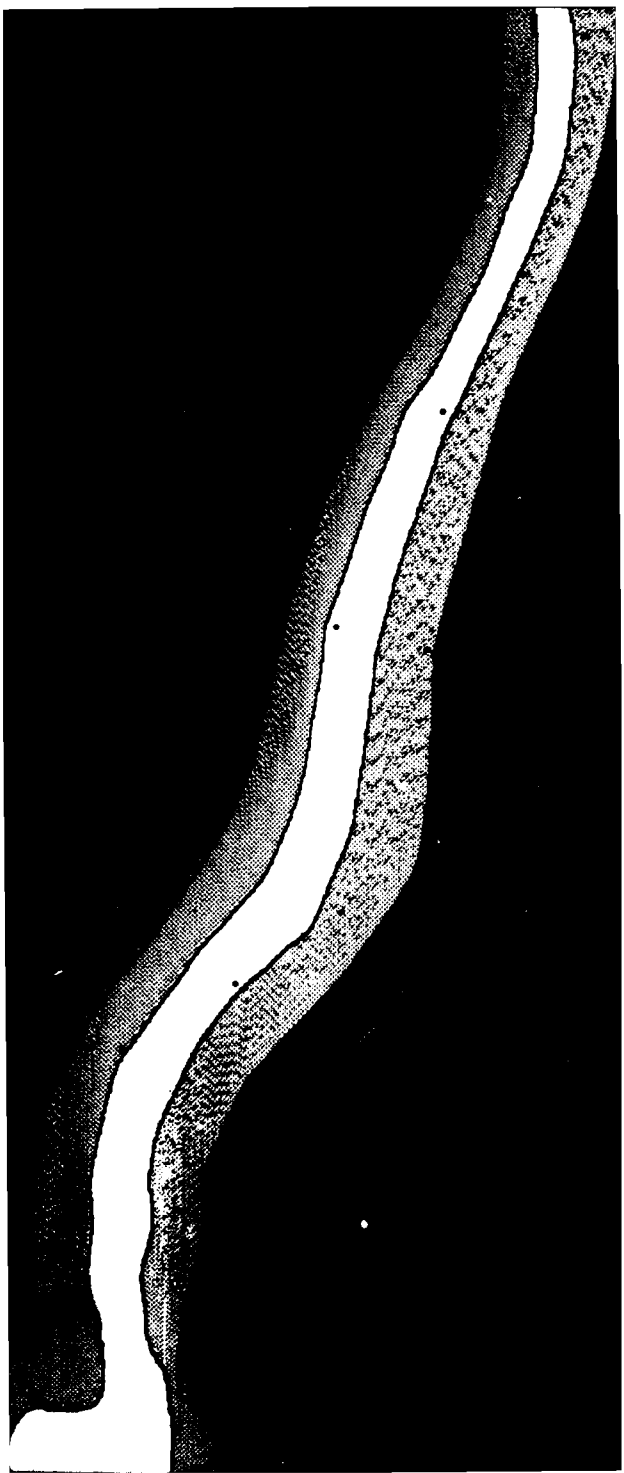
REMARKS

Dopplr Program
Prec. ephemeris
Oscillator drift 1.55×10^{-10} per day
Delay 0.731

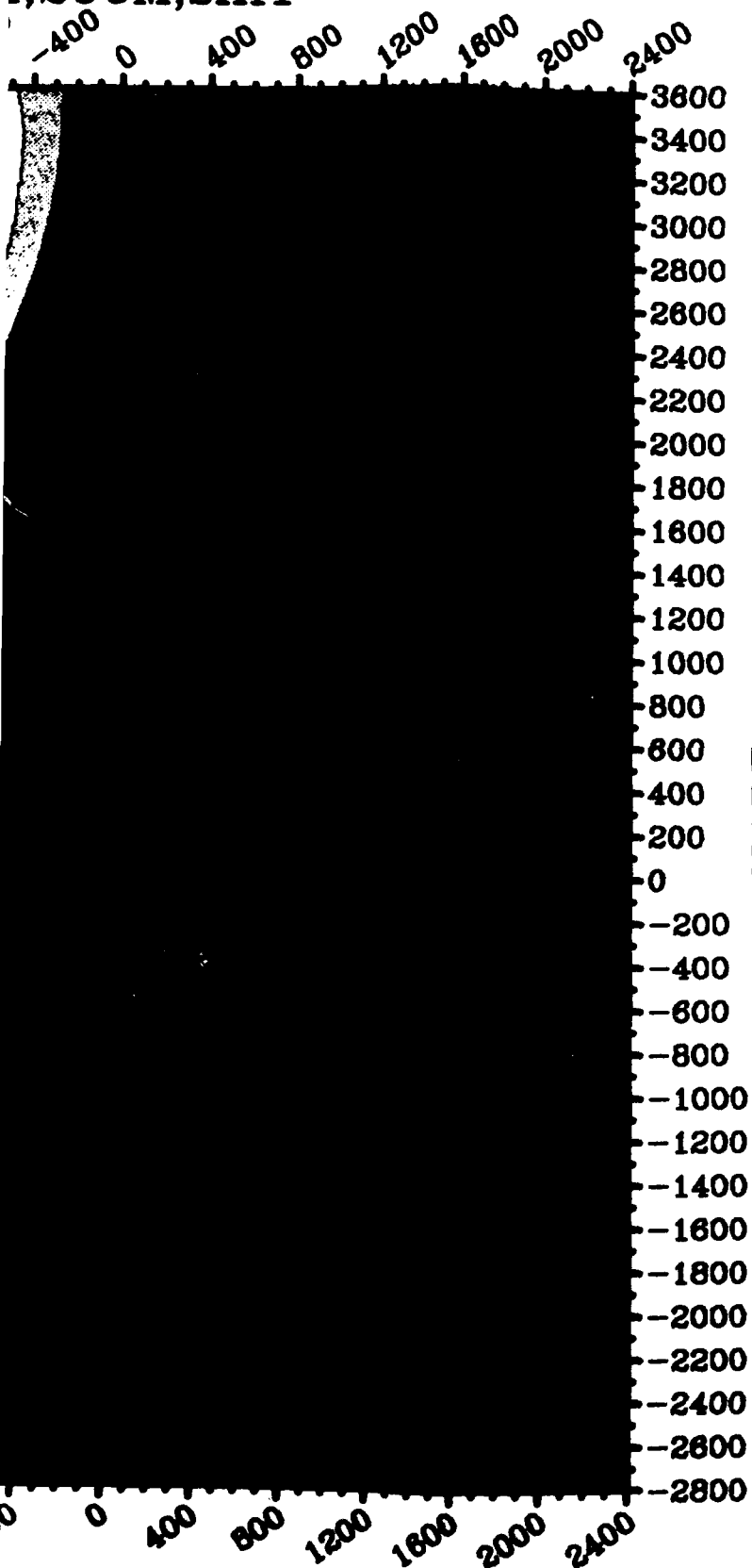
OTHER RELATED DATA FOR THIS STATION

| DATA | AVAIL. | LOCATION/REMARKS |
|------------------------------|--------|------------------|
| STATION OCCUPATION REPORT | | |
| GEODETTIC INFORMATION REPORT | | |
| STATION DESCRIPTION | | |
| SURVEY DIAGRAM | | |
| STATION SITE SKETCH | | |
| PHOTOIDENTIFICATION | | |
| ASTRONOMIC COORDINATES | | |
| STATION PHOTOS | | |

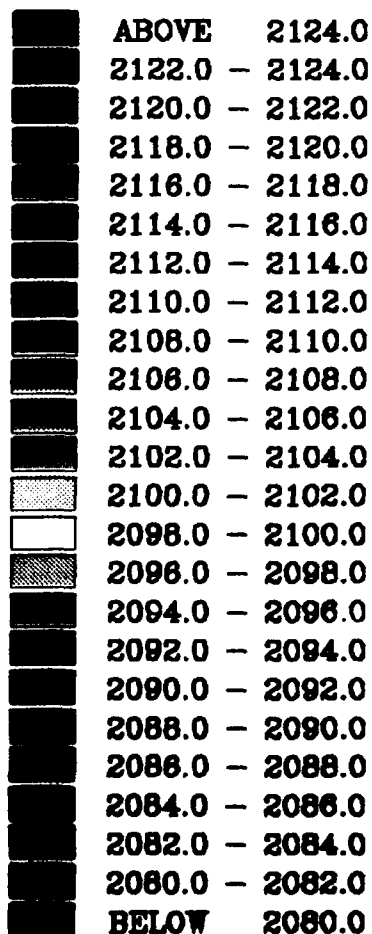
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| PREPARED BY/DATE NG 870514 | CHECKED BY/DATE NG 870514 | REVISED BY/DATE | CHECKED BY/DATE |
|-------------------------------|------------------------------|-----------------|-----------------|



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Dye2, surface elevation measurements

Sight from garage:

Elevation reference: snow at geociever site

| rot | dN | dE | dH | dH1 | deg | |
|---------|---------|---------|-----------|--------|----------|-----------------|
| -39.55 | 507.338 | -54.532 | -2.09 | 6.978 | 0.017453 | |
| Dist | Az | Elev | Az, korrr | N | E | H |
| 510.75 | 213.415 | -0.768 | 173.865 | -0.49 | 0.05 | -0.00 pole |
| 56.41 | 96.535 | -0.537 | 50.985 | 542.85 | -10.70 | 4.91 D2, SW cor |
| 1448.65 | 145.372 | 0.323 | 105.322 | 112.36 | 1339.23 | 13.20 runway |
| 1398.99 | 148.620 | 0.298 | 109.070 | 50.26 | 1267.68 | 12.30 runway |
| 1814.81 | 145.837 | 0.298 | 106.287 | -1.62 | 1687.45 | 14.55 |
| 91.38 | 31.870 | 0.230 | 42.320 | 574.90 | 6.99 | 5.26 D2, NW co |
| 81.39 | 118.580 | 0.217 | 79.930 | 522.83 | 25.37 | 5.20 D2, SE co |
| | | | | 554.88 | 43.06 | 5.20 D2, NE co |

Sight from garage, raw azimuth offset

| rot | dN | dE | dH | dH1 | deg | |
|---------|---------|---------|-----------|----------|---------|------------|
| 0.00 | 507.338 | -54.532 | -2.09 | 6.98 | 0.02 | |
| Dist | Az | Elev | Az, korrr | N | E | H |
| 510.75 | 173.865 | -0.768 | 173.865 | -0.49 | 0.05 | -0.00 pole |
| 917.52 | 177.672 | -0.312 | 177.672 | -409.43 | -17.26 | -0.05 |
| 1501.24 | 179.468 | -0.150 | 179.468 | -993.84 | -40.59 | 1.11 |
| 2198.76 | 179.848 | -0.033 | 179.848 | -1691.41 | -48.70 | 3.95 |
| 2642.65 | 180.375 | 0.025 | 180.375 | -2135.25 | -71.83 | 6.52 |
| 3122.67 | 180.622 | 0.068 | 180.622 | -2615.15 | -88.43 | 9.26 |
| 2599.91 | 132.752 | 0.282 | 132.752 | -1257.55 | 1854.58 | 18.15 |
| 2191.11 | 132.108 | 0.300 | 132.108 | -961.86 | 1571.01 | 16.69 |
| 1679.79 | 131.648 | 0.282 | 131.648 | -608.97 | 1200.68 | 13.35 |
| 1234.23 | 130.715 | 0.217 | 130.715 | -297.75 | 980.97 | 9.67 |
| 873.41 | 129.452 | 0.108 | 129.452 | -47.65 | 619.88 | 6.59 |
| 103.31 | 330.615 | 2.152 | 330.615 | 597.36 | -105.22 | 8.77 |

Sight from north of garage, west of station

| rot | dN | dE | dH | dH1 | deg | |
|---------|---------|----------|-----------|----------|----------|--------|
| 235.82 | 597.356 | -105.224 | -2.09 | 8.86 | 0.02 | |
| Dist | Az | Elev | Az, korrr | N | E | H |
| 606.93 | 294.197 | -0.825 | 170.020 | -0.39 | -0.04 | 0.00 |
| 621.11 | 354.046 | -1.175 | 229.871 | 197.04 | -580.12 | -5.94 |
| 1107.09 | 358.732 | -0.832 | 234.555 | -44.67 | -1007.14 | -9.22 |
| 1617.43 | 358.950 | -0.643 | 234.773 | -335.61 | -1426.46 | -11.20 |
| 2174.13 | 359.280 | -0.493 | 235.103 | -646.47 | -1886.41 | -11.61 |
| 2733.58 | 0.108 | -0.413 | 235.931 | -933.98 | -2369.63 | -12.42 |
| 3248.77 | 1.080 | -0.435 | 236.903 | -1176.67 | -2826.88 | -17.17 |
| 3293.69 | 9.315 | -0.468 | 245.138 | -787.43 | -3093.68 | -19.39 |
| 3313.66 | 18.080 | -0.520 | 253.903 | -321.41 | -3288.98 | -22.55 |
| 3405.87 | 27.183 | -0.595 | 263.006 | 182.64 | -3485.77 | -27.80 |
| 3373.27 | 37.833 | -0.663 | 273.676 | 813.63 | -3471.57 | -31.78 |
| 3276.99 | 46.510 | -0.705 | 282.533 | 1297.30 | -3306.61 | -32.81 |
| 2845.61 | 46.937 | -0.713 | 282.760 | 1225.91 | -2880.77 | -28.09 |
| 2346.69 | 47.000 | -0.718 | 282.823 | 1110.18 | -2393.40 | -22.26 |
| 1883.20 | 46.960 | -0.752 | 282.783 | 1014.03 | -1941.76 | -17.70 |
| 1384.11 | 46.850 | -0.832 | 282.673 | 901.01 | -1455.62 | -13.19 |
| 978.99 | 46.572 | -0.963 | 282.395 | 807.50 | -1061.40 | -9.61 |
| 526.95 | 47.042 | -1.383 | 282.865 | 714.68 | -618.95 | -5.93 |
| 593.68 | 100.150 | -1.167 | 335.973 | 1139.60 | -346.95 | -5.29 |
| 1022.26 | 90.472 | -0.818 | 326.295 | 1447.78 | -672.49 | -7.75 |
| 1530.61 | 88.330 | -0.710 | 324.153 | 1838.05 | -1001.59 | -12.03 |
| 2066.25 | 88.953 | -0.708 | 324.776 | 2285.29 | -1296.99 | -18.47 |

| | | | | | | |
|---------|---------|--------|---------|---------|----------|--------|
| 2689.27 | 89.750 | -0.690 | 325.573 | 2315.60 | -1625.63 | -25.12 |
| 3141.07 | 89.970 | -0.652 | 325.793 | 3195.07 | -1871.09 | -28.30 |
| 3087.72 | 98.398 | -0.583 | 334.221 | 3377.79 | -1448.08 | -23.99 |
| 2951.21 | 107.308 | -0.492 | 343.131 | 3421.59 | -961.62 | -17.97 |
| 2881.77 | 118.153 | -0.367 | 353.976 | 3463.22 | -407.65 | -11.12 |
| 2971.04 | 128.980 | -0.258 | 4.803 | 3557.97 | 143.54 | -6.00 |
| 2980.69 | 140.283 | -0.197 | 16.106 | 3461.06 | 721.67 | -2.87 |
| 2625.97 | 141.303 | -0.183 | 17.126 | 3106.89 | 668.06 | -1.14 |
| 2132.12 | 142.167 | -0.168 | 17.990 | 2615.73 | 550.20 | 0.86 |
| 1671.75 | 143.437 | -0.180 | 19.260 | 2175.54 | 446.21 | 1.71 |
| 1152.92 | 146.118 | -0.257 | 21.941 | 1666.77 | 325.57 | 1.69 |
| 897.79 | 147.993 | -0.363 | 23.816 | 1418.70 | 257.30 | 1.14 |
| 933.43 | 135.835 | -0.333 | 11.658 | 1511.53 | 83.39 | 1.41 |
| 861.66 | 132.015 | -0.435 | 7.838 | 1450.97 | 12.28 | 0.28 |
| 606.92 | 294.200 | -0.818 | 170.023 | -0.39 | -0.07 | 0.07 |

runway
runway
Polo

Sight from north of garage, west of station

| rot | dN | dE | dH | dH1 | deg | |
|---------|---------|----------|---------|---------|---------|-------|
| 0.00 | 597.356 | -105.224 | -2.09 | 8.86 | 0.02 | |
| Dist | Az | Elev | Az, kor | N | E | H |
| 606.93 | 170.022 | -0.818 | 170.022 | -0.39 | -0.06 | 0.07 |
| 893.94 | 52.848 | -0.218 | 52.848 | 1137.23 | 607.28 | 3.43 |
| 1324.72 | 52.643 | -0.032 | 52.643 | 1401.17 | 947.76 | 6.15 |
| 1959.97 | 52.350 | -0.002 | 52.350 | 1794.58 | 1446.60 | 6.97 |
| 2585.57 | 51.688 | -0.035 | 51.688 | 2200.26 | 1923.54 | 5.65 |
| 2595.52 | 62.158 | 0.045 | 62.158 | 1809.55 | 2189.83 | 9.27 |
| 2601.43 | 71.548 | 0.072 | 71.548 | 1420.73 | 2362.46 | 10.51 |